Glycemic Index & Diabetes Management

Joan Marie Warner, MS, RD, CDE

April 18, 2007

Glycemic Index

- GI first developed in 1981 by Dr. David Jenkins, professor of nutrition at University of Toronto, Canada
- Glycemic index is a numerical system of measuring the degree of rise in blood sugar in response to various carbohydrates
- The higher the blood glucose response, the higher the glycemic index.
- A GI of 70 or more is high, A GI of 56-69 is medium, and GI of 55 or less is low as compared to glucose which has a GI of 100

How GI is measured in the lab

- Pure glucose produces the greatest rise in blood glucose levels
- Pure glucose is set at 100 and every other food is ranked on a scale from 0 to 100

In the lab

- 1. An amt of food containing a standard amount of carbohydrate (usually 50 grams) is given to a volunteer to eat.
- 2. Over the next two hours (or three hours if the volunteer has DM), a sample of their blood is taken every 15 minutes during the first hour and thereafter every 30 minutes.
- 3. Blood-glucose level is plotted on a graph and the area under the curve is calculated using a computer program
- (cont.)

In the lab

- 4. The volunteer's response to the carbohydrate is compared with his or her blood-glucose response to 50 grams of pure glucose (the reference food).
- 5. The reference food is tested on two or three separate occasions and an average value is calculated.
- 6. The average GI value found in 8 to 10 people is the GI value of that food.

Gylcemic Index
why the difference?

- Structure of the food
- Starch composition
- Acidity of the food
- Fructose slower than , sucrose (glucose polymers high)
- Food fiber
- Method & length of time by which food was cooked
- Fat content slows digestion

High GI Index vs Low GI Index

- white bread……..70

- Cornflakes……….84
- Russets potato…85

- Whole grain pumpernickel bread…41
- All Bran cereal……42
- Yams………48

Low Glycemic Index Foods
to lower blood glucose levels

- HbgA1C lowered by low glycemic index diet
- Diabetes Care 1991

Also, glycemic index has and still is being looked at for weight control

Increase in body weight with a waist of a circumference of 30 inches or more increases insulin resistance

Increased insulin resistance by:

- Increase levels of estrogen & specific medications
- Stress related to cortisol/adrenal levels
- Decreased physical activity
- Deficiency of some nutrients (magnesium, chromium, vanadium, possibly the b-complex vitamins)

Increased insulin resistance by:

- Smoking
- Genetics
- Age
- Increase amount of saturated fats eaten at one time
- Increase amount of carbohydrates eaten at one time (lower glycemic food tends to be higher in fiber and often less dense in carbohydrates

"The New Glucose Revolution"

- The first book to popularize eating low-glycemic foods. Published in 1999.

- Authors: Jennie Brand-Miller, PhD, Thomas M Wolever, MD, PhD, Kaye Foster-Powell, Stephen Colagiuri, MD

Popular Speaker & Researcher

- *David Ludwig, MD, PhD*

- *Harvard Medical School, Assistant Professor of Pediatric & Children's Hospital & Director of Obesity Program in Boston, MA*

---

12 adolescents Short term Study
same carbs and fat, but protein different

Low GI	Medium GI	High GI
Egg/cheese	Steel cut oats	Instant oats
Spinach	Butter	Butter
Grapefruit	Milk	Milk
Milk		

Results

- The blood sugar was the highest in the highest GI group and lower in the lower GI groups.
- Blood sugar dropped lower than before in the high GI group
- Epinephrine levels increased in the HG group
- Kids in the HG group ate more later in the day

Long-term Study

- 16 obese adolescents
- 12 month study
- subjects all met with a dietitian 14 times during the study
- subjects were told to eat until satiety
- 8 of the subjects high GI foods, and 8 low GI foods

Results

- Over the year the low GI subjects lost more weight than the high GI subjects

- The high GI had a greater percent of body fat than the low GI group

Epidemiological Studies

- Populations with higher glycemic index diet had 37% great risk of type 2 diabetes
- Journal of Epidemiological Health

No Difference in weight loss with glycemic index

- Pawlak: Epidemiological evidence in small weight loss study in adolescents concluded there was no differences in weight loss for the kids eating low GI foods vs. moderate GI foods

- Pawlak, DB, Ebbeling CB, Ludwig DS.
- Obesity Review 3:235-244, 2002

Studies showing no difference in weight loss

- Carels et al. Adding Glycemic Index to Weight Loss Program Did Not Improve Outcomes. Eating Behaviors 6:145, 2005
- Raatz et al. Reduced GI and GL Do Not Increase the Effects of Energy Restriction on Weight Loss and Insulin Sensitivity in all groups. J. Nutr 135:2387, 2005
- Rabin A. GI Weight Loss and Appetite With Low and High Glycemic Foods. Obesity Reviews 3:245-256, 2002

Low glycemic did make a difference with blood glucose levels and weight loss

- Kiens B, Richter EA. Types of carbohydrate in an ordinary diet affect insulin action and muscle substrates in humans. Am. J Clin Nutr 1996;63:47-53.
- Percheron C, Colette C, Avignon A, Monnier L. Metabolic responses to high carbohydrate breakfasts in obese patients with impaired glucose tolerance: comparison of meals containing dairy products and fruits vs. bread. Nutr Res 1997;17: 797-806.
- Brand JC, Colagiuri S, Crossman S, Allen A Roberts DCK, Truswell AS. Low glycemic index foods improve long term glycemic control in NIDDM. Diabetes Care 1991; 14:95-101.

Problems with the Glycemic Index

- If high GI food is eaten in combination with low GI food, the GI response is moderate
- Insulin response to a given food is not linear and is not consistently related to either the CHO content or glycemic effect of the food (varies within the person depending on the time, and, from person to person)
- Not always the best indicator of healthy food choices (Snickers candy bar vs watermelon)
- Some studies did not always take into account the amount of carbohdyrate

Glycemic Index

- Australian potatoes: 87-101
- Canadian potatoes: 59-70
- Boiled rice: 45-112
- Bananas: 30-70
- Spaghetti: 45-65
- All-Bran (Australia)=30
- All-Bran (Canada)=51

- AJCN 76:5-56, 2002

Food	GI (sd)
Glucose	99+3
Potato, instant	85+33
Cornflakes	81+16
Bread, white	73+36
Watermelon	72+13
Rice, long grain	71+38
Oatmeal	58+4
Snickers bar	55+16
Banana	52+9
Spaghetti	47+27
Kidney beans	28+4
Apple	38+2
M & M's	33+3

To calculate the glycemic load of a quantity of carbohdyrate:

- Multiply the glycemic index value times the quantity of carbohdyrates of the servings in grams, then divide by 100

- GI value X grams per serving/100=glycemic load

Examples

- **White potatoes**: 5 ounces, 34 grams of carbs, glycemic index=85
- Glycemic load is 29 (34X85)/100

- **Yams**: 5 ounes, 34 grams of carbs, glycemic index=37
- Glycemic load is 13 (34X37)/100

Loads

- Glycemic load of 20 or above is high
- 11-19 is medium
- 10 or below is low

American Diabetes Association: 2006

- Monitoring the amount of carbohydrate remains a key strategy in achieving glycemic control

- The use of GI/GL may provide a modest benefit over that observed when total carbohydrate is considered alone.

United Nations FAO/WHO Consultation on Carbohydrates Recommended that "the glycemic index of foods be used in conjunction with information about food composition

Ideal Diet Plan
usually includes lower to moderate glycemic foods

- Stabilize blood glucose levels
- Increase foods high anti-oxidants and that have an anti-inflammatory effect on the body
- Balance nutrition (carbs, fats, protein)
- Fat content no more than 25%, protein 20-25%
- Nutrient dense foods
- Less processed foods
- Variety of unprocessed foods
- Fiber up to 35-45 grams a day

Counting carbs with fiber
"Complete Guide to Carb Counting" by Hope Warshaw, MMSc, RD, CDE Karmeen Kulkarni, MS, RD, CDE

- If there are more than 5 grams of fiber in the meal, then subtract the number of grams of fiber from the grams of total carbohydrate.
- 1 cup fiber cereal   =6 gms 32 carbs
- Sl whole grain bread =3 gms 12 carbs
- 1 c low-fat milk   =0 gms 12 carbs
- 1 ¼ cup strawberries =2 gms 15 carbs
                                  11   71

- 71-11=60 grams carbs

Fiber Sources
both types stay in the stomach longer

- Soluble………delays GI transit, delays glucose absorption, lowers blood cholesterol

- Insoluble…….speeds GI transit, slows starch hydrolysis, delays glucose absorption

Nutrition News

FIBER ONE Bran Cereal

How much fiber do we need?

- **A reasonable goal for dietary fiber intake for the average adult is 25 to 30 grams per day. For better blood sugar control, especially with type 2 diabetes, it is recommended to increase fiber to 30-45 grams per day.**

Fiber content of foods

- **Apples, medium, raw with skin, 3.5 grams**
- **Beans, 7-9 grams ½ cup -black beans, kidney beans, garbanzos, pinto beans**
- **Berries, 2 grams – ½ cup**
- **Bran Cereals, per ½ cup 8-14 grams - All-Bran, Bran Buds, 100% Bran**
- **Broccoli, per ½ cup 2.2 grams**
- **Brussels Sprouts, per ½ cup 2.3 grams**
- **Carrots, per ½ cup 2.3 grams**
- **Prunes 3- 3 grams**
- **Pear, 1 large 5 grams**
- **Green Beans, per ½ cup 2 grams - broad beans, pole beans, snap beans**
- **Greens, ½ cup 2 grams - beet greens, collards, kale, spinach, turnip greens**
- **Lentils, ½ cup 4 grams**
- **Lima Beans – 4.5 grams**
- **Peas, ½ cup 3.6**
- **Potatoes, ½ cup 2 (baked Idaho w/skin or sweet potato)**
- **Sweet Corn, ½ cup 3 grams**

Is the GI Practical?

- Yes if made simple

Comparisons

Seasonal Produce

Comparison of food examples

High glycemic	Med.glycemic	Low glycemic
Sticky white rice	*Brown rice*	*Long grain brown rice*
Baked potato	*Sweet potato or yams*	*Pasta*
Flavored fruit drinks	*Unsweetened juice*	*Whole fruit*
Instant flavored oatmeal	*Oatmeal short cooking*	*Old fashioned long cooking*

Comparison of glycemic index

Higher glycemic	Med, glycemic	Low glycemic
Pasta cooked for 40 minutes	Pasta cooked for 15 minutes	Pasta cooked for 6 minutes
Canned apricots	Fresh apricots	Dried apricots

Also Increased insulin resistance by:

- Increase levels of estrogen & specific medications
- Genetics
- Stress related to cortisol/adrenal levels
- Decreased physical activity
- Age
- **Deficiency of some nutrients (magnesium, chromium, vanadium, possibly the b-complex vitamins)**
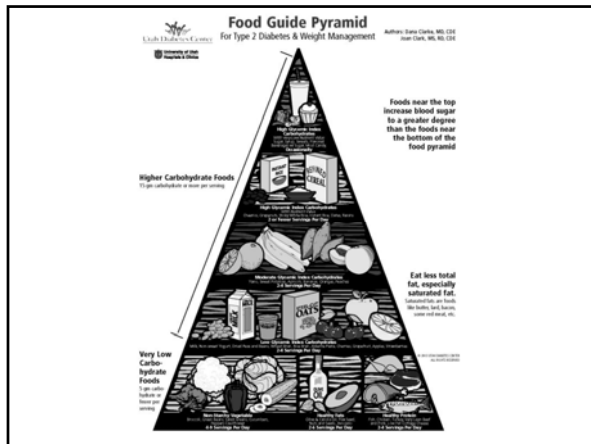
Health-Giving Carbohdyrates

- Fiber
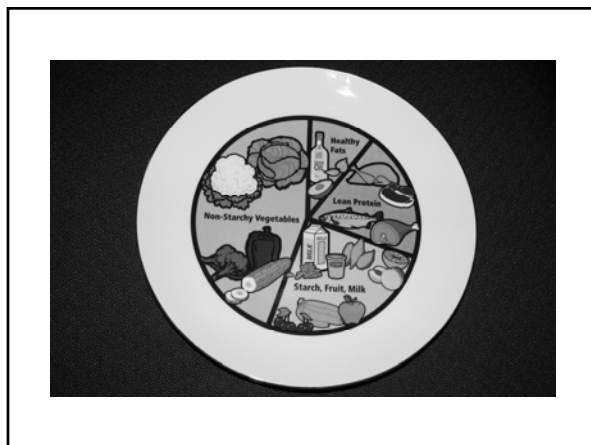- Vitamins and minerals
- Antioxidants

Lean Proteins & Healthy Fats added to the health giving carbohydrates

---

Decreasing insulin resistance

- Eat moderate amounts of carbohydrate at one time
- Eat lower glycemic carbohydrates
- Optimal nutrient intake
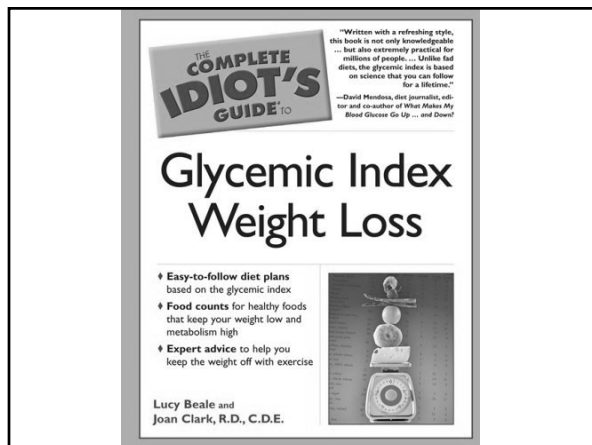- Decreased chronic stress
- Medication awareness
- Exercise

Important to spread out the carbohydrates

- Don't save carbohydrates for the next meal
- Don't skip meals
- Try not to skip snacks if needed
- Eat about the same amount of carbohydrates from meal to meal
- If still hungry add more of the non-starchy veggies

Menus: 40 grams of carbohydrate per meal

Breakfast	Lunch	Dinner
Spinach-Tomato Egg White Omelete (2 cups vegies & ½ c egg)	Chicken-Zucchini & Red Peppers with Pine nuts (two cups vegetables, 4 oz chicken, 1TB nuts)	Grilled Salmon with fresh Green Beans & Julienne Carrots (3 oz salmon, 2 cups vegetables, 1 TB nuts)
Blueberries with Non-fat Plain Yogurt (1 cup)	Whole-grain aldente' pasta (1/3 to 2/3 cup)	Brown Rice-Spinach Salad (1/3 c rice,1 c spinach)
Stone-ground whole-grain toast with ½ TB peanut butter	Purple Grapes (1/2 cup)	Berry Parfait (1 cup berries & ½ c FF Lemon Yogurt)

New Recipe Books

The Complete **IDIOT'S** GUIDE to

Terrific Diabetic Meals